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FOREST INSECT PROBLEMS OF CALIFORNIA

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I. Kinds of Forest Insects and the Losses They Cause.

Thousands of insects infest forests, many are innocuous, some beneficial, and a few are harmful. Every forest tree has its insect enemies. Some feed on cones, seeds, twigs, leaves, trunk and roots. Pines and firs have most insect pests. Redwood, cedars and junipers have least.

Certain steady loss is normal and is counter-balanced by growth. Epidemic outbreaks cause depletion of forest capital and this is what we should avoid through silvicultural practices, proper forest management, direct or indirect control measures.

II. Direct Losses.

The greatest timber loss is caused by two classes of insects: (1) Bark beetles and (2) Defoliators.

Defoliators - While such insects as the hemlock looper, fir tussock moth, spruce budworm and pine white butterfly have killed extensive forest areas in the northern states, this type of damage is practically unknown in California. The Pandora moth has defoliated Jeffrey pine in the Mono Lake area and the lodgepole needleminer has done extensive defoliation of lodgepole around Tuolumne Meadows in Yosemite; but the killing of timber has been caused by the bark beetles which follow the weakening of these trees.

Bark Beetles - By far the major loss of timber in California is due to bark beetles and by only about six species of these.

(1) Western pine beetle in ponderosa and Coulter pine.
(2) Mountain pine beetle in all pines but principally sugar pine, lodgepole, western white, and white bark pine.
(3) Jeffrey pine beetle in Jeffrey pine.
(4) Douglas-fir beetle in Douglas fir.
(5) Pine engraver (Ips) beetles in all pines.
(6) Fir engraver (Scolytus) beetles in tree firs.

Since pines are California's main crop tree, the four species killing pine are of most importance. Those killing fir take second place.

The chart attached shows the estimated loss from bark beetles in our pine stands since 1930. The downward trend is attributable to the extent to which susceptible stands have been covered with

some form of selective logging, and improved moisture conditions in recent years. We are making progress in licking the beetle problem.

No estimate has been made of the loss in fir stands. This we hope to get by a more intensive survey.

III. The More Important California Bark beetles and Their Control.

Since our major forest insect problems may be narrowed down to six bark beetles, it may be well to give some detailed consideration to each one.

1. THE WESTERN PINE BEETLE. Dendroctonus brevicomis Lec.

What it is - The adult western pine beetle is a small brown to black cylindrical rather stout beetle with a body somewhat smaller than the ordinary house fly. The larvae of the beetle are small, white legless grubs about one-quarter of an inch long with a small yellow head. They may be found by slicing halfway through the bark of an infested ponderosa pine and if the tree is at all heavily infested, they appear as so many grains of rice.

What it does - Boring through the bark, the beetles kill the trees by gnawing tunnels through the cambium layer, completely girdling them and thus cutting off the tree's sap. Besides attacking and killing standing green trees, it breeds to some extent in windfalls, broken or injured trees, and in the butts and cull logs left from logging operations or in the main trunk of trees felled in other types of cutting.

It confines its attack to the ponderosa pine, (and also Coulter pine in southern California) and to the main trunk of the attacked trees. Rarely does it go into tops less than six inches in diameter, or into the limbs.

Conditions favoring outbreaks - These beetles favor unhealthy intermediate or suppressed trees that have been weakened by drought, stand stagnation and show a reduction in growth rate. They breed in windfalls, in the main bole of trees top-killed by Ips and in fire-killed trees. During epidemic periods it builds up in weak trees and then expands into healthy trees of all classes.

Control - Losses can be reduced by direct control measures and held to a minimum by yearly maintenance control provided such cost can be justified.

Outstanding success has been obtained by indirect control through sanitation-salvage in eastside stands and we favor this method wherever it can be applied.

Survey Needs - We know that the western pine beetle is distributed throughout the ponderosa pine stands of the State. There is no need to detect it. What we want to know is the trend of loss and

the first sign of outbreaks. This requires systematic sampling. We also want to know what stands are most susceptible. This requires a special hazard survey. Such hazard surveys were made of northeastern California in 1941 and now need rechecking. We have started this work on the Lassen forest.

2. THE MOUNTAIN PINE BEETLE. Dendroctonus monticolae

What it is - The mountain pine beetle is very closely related to the western pine beetle and similar in appearance to it except that the adult of the mountain pine beetle is slightly larger and has a more glossy black color. The adults are small, stout, cylindrical, black beetles about a quarter of an inch long. The larvae, if full grown, are about the same size as the beetles and are white and legless with small yellow heads. The pupae are also white, with spines on the abdomen, and may be seen in cells within the inner bark when the bark is removed from an infested tree.

What it does - Like the western pine beetle, the parent adults bore through the bark and cambium, slightly scoring the surface of the sapwood, but the gallery, instead of winding in an irregular pattern, follows up the grain of the wood after making a short crook at the entrance. The tree does not die from the effect of the adult attack, but succumbs only after the larvae have hatched and worked out at right angles from the egg gallery and girdled the tree.

Conditions Favoring Outbreaks - In lodgepole and western white pine stands, this beetle makes a clear cutting of these stands when they reach the susceptible age of 100 to 150 years.

Since lodgepole and western white pine are of little economic importance in California, we are more concerned with its killing of sugar pine. Here we are not at all sure of what constitutes a susceptible tree or stand. Stands on shallow soil or with heavy competition from fir appear to be more susceptible. More study is needed on this problem.

Control - Epidemic losses can be reduced by direct control measures. Greater success from direct control has been obtained than with western pine beetle. Indirect control cannot be applied as we have not learned to recognize susceptible trees.

Survey Needs - This beetle is present in all pine stands, and some loss can be expected every year. Plot measurements are needed to determine trend of epidemics and need for direct control measures.

3. JEFFREY PINE BEETLE

What it is - and does - This beetle attacks Jeffrey pines in California, and for the most part confines its work to this tree. The type of galley is very similar to that made by the mountain pine beetle, and consists of one long straight galley, with a slight curve near the entrance and branching larval mines.

Conditions Favoring Outbreaks - This beetle seems to favor unhealthy, slow-growing trees and hence can be controlled by sanitation-salvage cutting like the western pine beetle. It has rarely appeared in epidemic form and hence direct control is seldom warranted.

Survey Needs - Hazard surveys to determine location of susceptible stands are of more value than detection surveys, for it is present in all Jeffrey pine stands in the northern part of the State.

4. PINE ENGRAVER BEETLES (Ips)

What they are - The adults are of rice-grain size, reddish brown to black, shiny cylindrical bark beetles and are easily recognized by a pronounced cavity on the rear end, which is margined with from one to six pair of stout spines. The larvae and pupae are small and white and not very different from other bark beetle larvae.

What they do - Their normal habit is to feed on the cambium of recently felled coniferous trees, and they breed very readily and in large numbers in such material as windfalls, snowfalls, snowbreak, logging and road slash. After increasing in number in such material, they often emerge in large numbers and kill adjacent groups of young pines and the tops of older trees. Usually, however, such epidemic killings of living trees are of short duration and ordinarily after one season the beetles return to their diet of freshly felled logs and tops.

Like most bark beetles, the adults bore between the bark and wood and construct an egg gallery along which the eggs are laid. The male beetle starts the attack, and upon reaching the cambium constructs an entrance or nuptial chamber. Several females then join in the work and each constructs an egg gallery, free from packed boring dust, radiating from the central nuptial chamber, cutting through the inner bark and slightly scoring the sapwood. Eggs are laid in niches along the sides of the egg galleries, and the larvae upon hatching feed out from the egg galleries at more or less right angles to them. The feeding is confined to the inner bark.

Conditions Favoring Outbreaks - These beetles are a problem of logging areas. They breed readily in slash and then boil out to attack standing trees. Spring slash on sporadic shot-gun cutting and highway slash laid down from June to August 1 is the most dangerous.

Control - The problem of Ips control is largely one of prevention through proper slash disposal. Lopping and scattering of slash is the most feasible method of keeping populations down. After standing trees are killed the damage has been done and little is to be gained by direct control measures. Ips outbreaks are characteristically sporadic and die out as quickly as they appear. Prevention is the word. A state forest practice law is needed to require slash disposal for Ips control

Survey Needs - In order to have some estimate of the losses being caused by Ips beetles, outbreaks should be reported. As these are sporadic, no system of sampling is appropriate. Rather, individual outbreaks can be reported as covering so many acres and involving so many trees.

(5) DOUGLAS-FIR BEETLE

What it is - The adults are reddish to blackish brown bark beetles about a quarter of an inch in length and very similar to the other bark beetles just described except for their reddish color and their covering of conspicuous long hairs. The larvae are small white legless grubs which feed in mines located in the inner layers of the bark.

What it does - The adult beetles bore through the outer bark and construct perpendicular, nearly straight, or slightly sinuous egg galleries in the inner bark. These galleries slightly etch the sapwood. The galleries vary in length from 6 to 30 inches, but the majority are 12 to 14 inches long and from one-quarter to almost 3/4 of an inch broad. The eggs are placed in masses of from 10 to 32 in grooves at alternate intervals along the sides of the galleries. The eggs hatch into small larvae which feed out nearly at right angles from the egg gallery. These larval mines soon diverge so that, as they gradually expand with the growth of the larvae, they will not interfere with each other, occasionally the mines are tortuous and may cross and recross one another. In thin-barked trees the pupal cells at the end of the larval mines may be exposed to view when the bark is slipped from the bole of the tree, but in thicker bark trees the pupal cells are usually concealed. In these cells the transformation from larvae to pupae and then to new adults takes place. When this transformation is complete, the new adults bore away the intervening bark between pupal cells and congregate for rather long periods beneath the bark. Finally, the new adults emerge from the trees through holes constructed in the bark or take advantage of cracks and other openings. The beetles then fly and make their attack on other trees.

Conditions Favoring Outbreaks - Not an aggressive beetle unless populations are built up by fires or windfalls. Then healthy trees may be killed in groups.

Control - No direct control has been attempted in California or Oregon for this beetle. Since its outbreaks are short-lived and depend so largely on fire-killed or other weakened material, prevention through fire control and keeping stands in a thrifty condition are more important than direct control measures.

Survey Needs - Douglas-fir presents a limited problem in California and there seems to be little need to survey for insect losses, since control would rarely if ever be advocated. Drain surveys to determine net yields of Douglas-fir stands would be of interest, but not from the insect-control standpoint.

(6) FIR ENGRAVER BEETLE

What they are - These are small, shiny dark or nearly black bark beetles somewhat less than one-fifth inch in length. They are characterized by the concave appearance of the under surface of the abdomen at its rear end. The wing covers extend beyond the tip of the abdomen which looks as though it had been bitten off from underneath. The larvae are small white legless grubs similar to other bark-beetle larvae.

What they do - Each attack is made by a pair of beetles, a male and female. They bore through the outer bark of a tree selected for attack. When they reach the wood, they construct an enlarged chamber in which they mate. From this nuptial chamber, a short, straight egg gallery is constructed, partly in the inner bark and partly scoring the sapwood. In some species, two horizontal egg galleries issue from each nuptial chamber and in one species only one vertical egg gallery is made. The eggs are laid in niches along each side of the egg galleries and are placed very close together. The female deposits eggs as the construction of the gallery progresses. The eggs laid near the entrance hatch first. The larvae work out at right angles from the egg galleries and form a very distinctive pattern in their work.

Conditions Favoring Outbreaks - These beetles appear to favor mature or decadent trees and outbreaks occur when drought conditions put stands in a state of strain. Young stands may be attacked but usually when they are crowded.

Control - Since this beetle may attack green trees without killing them and may be present in large numbers without being detected, no control appears to be feasible. The best precaution is to keep stands in a thrifty, fast-growing condition and harvest them at an early rotation age.

Survey Needs - Since no control is feasible, there seems to be little need in carrying on detection surveys. Growth and drain surveys would be of interest to forest managers.

SUMMARY

Forest protection from insects in California simmers down to preventing or controlling loss from four species of pine bark beetles. Much can be done in preventing loss through proper forest management or through the application of sanitation-salvage. Direct control is sometimes needed for the western pine beetle and mountain pine beetle. For the other species, control is seldom needed or is not feasible. In other words, our complex forest insect problems resolve themselves into surveying for and applying control for just two species, i.e., the western pine beetle and the mountain pine beetle. You will hear more about these two public enemies.